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VERBALIZATION OF PROBLEM-SOLVING BEHAVIOR

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VERBALIZATION OF PROBLEM-SOLVING BEHAVIOR

CHAPTER I

INTRODUCTION

While awareness does not seem to be an appropriate concept in the description of the behavior of animals, the role of awareness must be considered for an understanding of the learning processes of humans. Kanfer and Marston (1961) formulated the issue concisely: "Awareness can be conceptualized as a mediating class of responses which controls learning of subsequent responses or as a coincidental class of responses which only sometimes correlates with learning" (p. 463).

Unfortunately the word "awareness" has been operationally defined by various experimenters to serve the defense of their own biases. The result has been conflicting conclusions based on conflicting definitions. No satisfactory resolution of the issue of the presence or absence of awareness in learning has been reached.

The relevance of the body of research on awareness extends to the dynamics of human behavior. Eriksen (1960) pointed out that:

> Common sense tells us that we are constantly utilizing cues of which we are unaware in our perception of depth, of shape and size constancy, as well as a number of cues that guide such complex motor habits as piano playing and driving automobiles (p. 293).

To the degree that laboratory learning situations are analogous to human experiences in general, findings can be applied to improving the understanding and treatment of deviant behavior.

> Among clinical psychologists it is widely believed that in ordinary social interaction people often respond, in ways of which they are unaware, to stimuli which they are unaware they are responding to, and that such behavior without awareness can be of special importance in psychopathology. In therapy great stress is placed on the importance of becoming aware of the stimuli to which one responds, of the response one makes, and of the reasons that one responds in the way one does (Adams, 1957, p. 384).

Further, the research questions how non-directive therapy is. In discussing Carl Rogers' report of the treatment of Herbert Bryan, Frank (1959) said:

> The therapist presumably believed that he was not influencing the patient's productions, yet different raters were able to classify his interventions as implicitly approving or disapproving with a high degree of reliability. Apparently a therapist can strongly affect his patient's productions without being aware that he is doing so (p. 28).

Awareness Defined by Learning Curve

At this point the bulk of research has been addressed to the question of determining if learning can occur without the learner's awareness of what, how, or why he is learning.

The focus of attention has been on the word "awareness". Awareness is a hypothetical construct which must be determined from other measurements. Thorndike and Rock (1934) defined awareness as a sudden rise in performance of a learning task. Conversely, gradual acquisition was concluded to indicate learning without awareness. They demonstrated their hypotheses with a verbal task and a motor task. Subjects were asked to free associate to a list of words. When their responses were prompted by sequential usage, the experimenter said "good". When their responses were definitional in nature, the experimenter said "wrong". In the motor task the subject was required to place his forefinger on one side of a board and to place a pencil point at the same spot on the other side of the board. If the subject was off the point within a given radius in a given quadrant, the experimenter said "good". In both situations subjects acquired the desired behavior gradually.

However, Irwin, Kauffman, Prior, and Weaver (1934) undertook a further test of the conclusions of Thorndike and Rock. They used the verbal association task, but instructed some of their subjects as to the purpose and principle involved in making correct responses. The informed subjects did not have a sharp rise in correct responses, continuing to improve gradually. These experimenters maintained that awareness does not inevitably produce a sudden increment in appropriate performance and hence, slow acquisition can not be considered proof of learning without awareness.

Postman and Jarrett (1952) replicated the preceding experiment with one modification. They divided the stimulus word list into 12 blocks and questioned each subject at the end of each block to determine at what point, if any, the subject was aware of the correct solution. At the outset they did not provide the subjects with any verification of the adequacy of their solutions. Those subjects who were informed during the experiment showed an abrupt change in performance immediately following receipt of the pertinent information. The subjects who were not informed showed small amounts of improvement through the block of trials after which they correctly stated the principle and then promptly produced a substantial gain in correct responses. The data seems to support the Thorndike-Rock view that learning occurs without awareness although less efficiently than learning with awareness.

Awareness Defined by Self Report

The shape of the learning curve does not appear to afford a definitive identification of awareness. The method of questioning subjects has been much more widely used. "The most frequent definition of awareness and unawareness is in terms of verbal report. Awareness is equated with the ability to verbalize and unawareness with the inability or lack of verbalization"(Eriksen, 1960, p. 280). Researchers have found it convenient to use the oral or written reports of

subjects as criteria of subjects' awareness. "For practical experimental purposes it has been necessary to equate awareness with the capability to verbalize certain events" (Kimble, 1962, pp. 43-44). What might be a simple direct approach to the problem has created the issue of the proper means to the end of eliciting the reports that serve to categorize subjects as aware or unaware and demonstrate that learning can or cannot occur without awareness.

> First, there is the trivial point that it seems unlikely that learning occurs at all in generally unaware subjects, such as those who are deeply asleep. If this is what is meant by learning without awareness, there is no secure evidence that such learning ever occurs. Experimenters in this area, however, define awareness somewhat differently, in terms of the recognition of certain experimentally arranged contingencies (Kimble, 1962, p. 44).

There is no standard technique. Experimenters have used interviews and questionnaires of varying content and length administered periodically during the testing, after performance indicates learning has occurred, at the end of the test, after an extinction period, and after some lapse of time. From their available data, they have arrived at a dichotomous classification from which they infer that subjects were or were not learning with awareness.

A departure from the either-or categorization of subjects was made by Davis and Hess (1962). They determined levels of awareness for their subjects and found that learning was related to the level of awareness. In some experiments the concern has been only with the subject

becoming aware of the correct response which Dulany (1962) has labeled Behavioral Hypothesis. Other experiments have measured awareness of Dulany's Reinforcement Hypothesis which involves two steps, the first being awareness of the occurrence of some reinforcement, and the second being awareness of the relationship of the reinforcement to the correct response class.

Behaviors which have been conditioned in the experimental laboratories have been verbal, motor, and autonomic. They have included attitude formation and change and problem-solving. Reinforcements used have been verbal, perceptual, auditory, and tactual, both positive and negative.

Research on Changing Verbal Behavior

One commonly used technique requires the subjects to construct sentences using one of a list of pronouns with a given verb. The use of the first or third person pronouns is reinforced. In such cases where the singular and plural forms are both correct, a solution using only the singular or the plural would be partially correct, but would lead to 100 percent reinforcement. Cohen, Kalish, Thurston, and Cohen (1954) presented this task to medical patients in a veterans hospital. They reinforced correct responses by the experimenter saying "good". Subjects were given 80 trials at the end of which they were questioned to determine if

they were aware. There was no reported awareness. The reinforced group of subjects had a significant rise in their usage of first person pronouns. The control group did not. An additional 80 trials were then given without reinforcement and a lowered rate of usage indicated that extinction was taking place. The same task and reinforcement were used by Barnett, Pryer, and Ellis (1959) with institutionalized mental defectives. Their subjects were not aware; the experimental group conditioned and the controls did not.

Twelve groups of subjects from a hospital population were used by Leventhal (1959). They were divided by diagnosis as medical patients, neurotics, and schizophrenics. Within each category four groups were reinforced differently. One group were told "good" when they gave the correct responses. Another were told "not so good" when they responded incorrectly, while a third group received both the positive and the negative reinforcements. A control group were told nothing. At the end of the 60-item test subjects were asked five questions to determine if they were aware, and those who were judged as aware were eliminated from the analysis. All of the reinforced groups among the medical cases, who were considered normal mentally, differed significantly from the control group. The negatively reinforced neurotic group and the positively reinforced schizophrenic group did not perform differently than the controls.

To control the possibility of a verbal reinforcement varying in inflection and, hence, in meaning to the subjects,

Wolpin and Milgram (1962) recorded the word "good". They selected for use two vocalizations of the word, one rated by judges to convey positive connotations and one rated as equivocal. A 16-item interview determined awareness. Approximately half the subjects who increased their use of first person pronouns fell in the unaware category. There was no difference in the two reinforcement groups.

De Wolfe (1962) followed Adams' (1957) suggestion that solutions that are partially correct should be considered in evaluating awareness. He reinforced the use of first person pronouns with "good". Following extinction trials, he asked his subjects how they selected pronouns and if anything he said influenced their choices. On the basis of their answers, he classified subjects as aware, partially aware, and unaware. The three classes of subjects were not statistically different in their performances.

Farber (1963) found no relation of performance on the sentence construction task to intelligence, manifest anxiety, or introversion. He did find that conformity and set were determining variables. He verbally reinforced the pronoun "you". After 20 trials, half the subjects were instructed that they were doing poorly. In all, 80 trials were given before a questionnaire was administered to determine awareness and conformity. Subjects who were given failure instructions performed at a lower level than those who were not. However, when he considered aware and unaware

subjects separately, instructions did not account for significant differences in learning; that is, the instructions influenced the awareness rather than the learning directly. The conforming subjects were superior to the non-conformers. Since some of his aware subjects did not learn and some of his unaware subjects did learn, he concluded that learning can occur without awareness although less efficiently. He suggested that some learning precedes awareness.

Half the subjects who participated in an experiment conducted by Dixon and Oakes (1965) were given a color-naming task between trials on the sentence-completion task. All subjects received the same reinforcement of "good". There was no statistically significant difference in the performances of the subjects who had the interfering inter-trial activity and those who did not. The color-namers were not able to verbalize the relevant solution.

Spielberger, Levin, and Shepard (1962) criticized the interviews and questionnaires that indicated that learning occurred without awareness on the grounds that they were not extensive enough. After subjects completed the sentence-construction task, reinforced with "good", they were asked four general questions similar to those other researchers have used, and then answered a number of more specific questions. The subjects who did not state correct solutions at any time did not show that they had learned. The aware subjects were classified according to whether they

stated correct solutions during the brief or extended interview. The mean for the brief interview subjects was much higher but because of their wide variability, there was no statistical difference in the two groups.

College students and neuropsychiatric patients were reinforced in three ways by Buss, Gerjuoy, Irma, and Zusman (1958). One group was given the conventional treatment of "good" for the correct pronoun. A second group was given chips that could be exchanged for cigarettes or candy. The third group was given non-exchangeable chips. At the end of the experiment, the subjects were asked what relation the experimenter's behavior had to their own behavior. The only group in which learning occurred that did not verbalize the correct contingency were the patients who were verbally reinforced.

A brief and extended interview was used by Levin (1961) with neuropsychiatric and medical patients after 100 trials. The 16 subjects who verbalized the correct solution during the extended interview showed better learning than the 35 subjects who verbalized awareness during the brief interview. The 41 unaware subjects did not differ from the control subjects who had received no reinforcement. However, subjects who indicated that they were not aware in any way of the reinforcement "good" learned as well as those who were aware of the reinforcement.

Binder and Salop (1961) used a slightly different sentence-construction task. They reinforced the use of

past-tense verbs. One subject group was told "good", another was shocked electrically, and another was a control group not receiving any reinforcement. All subjects who were judged to be aware of the purpose of the experiment were eliminated from the analysis. The first group showed the best acquisition and the slowest extinction. The second group showed the fastest extinction.

The differential effects produced by different experimenters were studied by Binder, McConnell, and Sjoholm (1957). They verbally reinforced the choice of hostile verbs from a list of verbs in a sentence-construction task. Their interview determined that unaware subjects learned. They found a significant difference between the subjects conditioned by the two experimenters.

Kanfer and McBrearty (1961) used a similar task to explore the role of the discriminability of the stimuli. Only two verbs were presented on each trial. For one group of subjects a neutral verb was paired with a mildly hostile verb. For the other group a neutral verb was paired with an intensely hostile verb. Each time a subject chose a hostile verb the experimenter said "good". A six-item questionnaire was the basis for determining awareness. Stimuli with high discriminability produced more awareness, but poorer learning for the unaware subjects. The aware subjects learned better, but the unaware subjects did learn.

The preceding experiment was replicated with additional variables by Kanfer and Marston (1961). Besides

discriminability, they investigated the ambiguity of the reinforcement by telling one group of subjects "good" and flashing a green light, which they considered more ambiguous, for the other group. They also varied the instructions they gave; half the subjects were told that they would score points each time they were reinforced. A transfer situation was introduced after 100 trials. Then an interview determined if the subjects were aware. Results showed the aware subjects were able to perform the transfer task better. More subjects who were reinforced by "good" were aware, but did not learn significantly better. The subjects who received more information in the instructions learned better. An analysis of the data considering sex of the subjects revealed no differences between males and females.

Dulany (1962) conditioned the use of "I", "we", active words, and hostile verbs with electric shock, a mechanical tone, and a verbal "um-hmm". He found that the particular task or reinforcement was not a significant source of variation in performance. Neither was the amount of information given to the subject, when only subjects who were aware were considered. He also found that arousing hostility in the subjects produced poorer performance.

Subjects had to use two cues to determine which words in a 16-word list were correct to elicit "good" from the experimenter in a study conducted by Krieckhaus and Eriksen (1960). Subjects were told "no" when they chose incorrectly.

The cues were semantic and color. For half the subjects the correct words were related to the sea and were in a specific color. For the other half the correct words were related to farming and were in a specific color. An extensive interview was used to obtain an evaluation of awareness. Incorrect solutions were checked to determine if they would lead to better than chance performance if they were followed. In no case was it found that they would. Learning for the aware subjects was much better, but unaware subjects did learn more than the controls who received no reinforcement. The experimenters suggested that some of the unaware subjects might have been misclassified. It was also possible that some of the aware subjects stated a correct solution by chance and so were misclassified since 32 percent of the control subjects were able to state the correct solution.

In a word association task, Weiss (1955) reinforced any reference to living things. There were 240 words divided into 12 blocks. At the end of each block the experimenter questioned the subjects to determine awareness. Half the subjects were told they were being timed but the set for speed was not a significant factor. One group of subjects were informed of the principle after which they showed a sharp rise in acquisition. The only significant changes in the learning curves of the uninformed subjects occurred at the point of verbalizing the principle.

There was no indication of learning without awareness in two experiments conducted by Wilson and Verplanck (1956) because almost all their subjects were aware. In the first study the subjects were told to speak words without repeating and without forming sentences. Each subject gave 800 words, the first 100 to determine their operant rates. For the next 300 half the subjects were reinforced for plural nouns, the other half for adverbs. No reinforcement was given for the next 100 words, and the final 300 were reinforced according to the principle not previously used for the subject. In the second experiment travel words or references to living things were reinforced and the transfer task was eliminated. Reinforcements were "mmm-hmmm", "good", and the experimenter writing down the word. Some subjects interpreted the writing down as a negative sign and consequently displayed a sort of negative learning.

Greenspoon (1955) used the same sort of verbal task. He said "mmm-hmmm" every time the subject gave a plural word and "huh-uh" for all other words. He used four questions in the interview portion of the experiment to eliminate subjects who were aware of the purpose of the experiment. The unaware subjects increased their use of plural words while they were being reinforced and decreased their use of plural words when the reinforcement was omitted.

Sidowski (1954) had previously used the Greenspoon technique, but used a visual reinforcement, a light. There

were four groups of subjects. Group I were instructed to try to turn on the light by reciting the right words and were presented the light every time they spoke a plural word. Group II were not told to try to turn on the light, but the light was turned on when they gave plural words. For Group III the light was turned on randomly, and Group IV received no reinforcement. After each subject gave 325 words, he was asked two questions to reveal if he was aware. On that basis three subjects from each of the first two groups were eliminated. Although the mean for Group II was higher than the mean for Group I, it was not statistically significantly so. Both Groups I and II were significantly above Groups III and IV. While Matarazzo, Saslow, and Pareis (1959) were able to condition human responses, they were not able to condition plural responses.

To avoid any influence in the subjects' reports of awareness caused by reactions to the experimenter, Weinstein and Lawson (1963) used a confederate to interview subjects. The confederate posed as another subject who was waiting to take part in the experiment. During the time the confederate and the subject were left alone, the confederate asked a number of questions about what the experiment was all about. The experimenters administered two further tests of the subjects' awareness, which called for a great deal of inference. Subjects were asked to check appropriate words in a list and to write down other appropriate words.

However, the two tests offer no more evidence of awareness than the Greenspoon task itself. Four groups of subjects recited words for forty minutes. There were a control group that were not reinforced, one group that were reinforced with a verbal "good" and a nod of the head, another reinforced group that were told after 20 minutes that correct responses were being reinforced, and a reinforced group that were told after 20 minutes how to respond. The procedure was an attempt to control awareness. The experimenters reported that the fully informed subjects in the fourth group did not all verbalize the correct contingency. The uninformed but reinforced subjects did not differ from the control subjects.

Speilberger and DeNike (1962) used an extended interview after administering the Greenspoon task and found no subjects who were aware. Neither did they find any evidence of learning by a count of plural words spoken during a set time period or by the percentage of all words spoken that were plural in form. Their control and reinforced subjects were matched for operant rate of emitting plural words.

College students who had been academically exposed to the verbal conditioning phenomenon were subjects for Krasner, Weiss, and Ullman (1959). Only 38 percent of these relatively sophisticated subjects reported awareness. Their levels of performance were not related to awareness.

Research Using Problem-Solving Tasks

A problem of number relationships was used by Philbrick and Postman (1955). Subjects were told that the experimenter would recite a list of words after each of which they were to give a number between one and nine, and each time they gave the correct number they would be told "right". The correct solution was the number that was one less than the amount of letters in the word. The list contained 216 words divided into 24 blocks. After every block in which four responses were correct, the subject was asked to verbalize his solution. The 20 subjects who verbalized correctly showed significant improvement before verbalization and a sharp rise in performance at the point of verbalization. For the 28 subjects who were not aware, the improvement was slower but still significant.

The same task was used by Hirsch (1957), who studied the role of the reinforcement. He told some subjects when they were right, other subjects when they were wrong, and other subjects when they were both right and wrong. He gave half his subjects partial reinforcement and the other half continuous reinforcement. There were 324 words in 24 blocks plus 12 for extinction trials. He followed the same procedure of inquiry as Philbrick and Postman. The type and schedule of reinforcement were not related to acquisition, but were related to extinction. Improvement occurred

before the correct solution was given. No subject gave an incorrect solution that could have improved performance.

Sassenrath (1962) employed the Philbrick-Postman method with an additional transfer task for which the correct solution was subtracting the number of letters in the word from 11. Subjects with partially correct solutions were not included in the unaware group which learned better than the control group on both tasks. The best performers on the transfer task had been informed of the principle for the transfer at the start of their trials.

Davis and Hess (1962) did not reinforce solutions to their anagram task, since the subject knew when he had solved a problem. The experimenters were interested in determining if subjects developed a pattern for the solutions without awareness. During the training trials, each anagram could be solved by making the same shift of letters according to position. For each of the test trials there were two possible solutions, one of which followed the principle that was involved during the training trials and was considered correct. Learning was measured by the number of correct solutions and by response latency. Three open-ended questions in written form were the basis for classifying subjects by levels of awareness. Both measures of learning were directly related to the levels of awareness.

Teska (1942) used a series of ten problems that required a motor response in a multiple-choice situation.

Subjects were shown a square screen divided into quadrants next to each of which was a button and told to try to light the red light above it by pushing the correct button. On each trial two quadrants were blank, one contained a triangle, and one a square. For some of the problems two colors were added as cues in addition to the shapes and spatial relations. Since the researcher was primarily interested in the problem-solving process, he attempted to get subjects who had indicated they had learned the solution by illuminating the light on several successive trials to verbalize their solutions. He found that some subjects who had learned could not verbalize correctly. Some of the subjects did state incorrect solutions and then continued to respond correctly. Hensley (1957), who used the same task, found no evidence of learning without awareness.

Tatz (1960) instructed his subjects to recite numbers in groups of three. Each time the subject gave one of two correct numbers, he was reinforced. Half the subjects were told "good", and the others heard a click. Half the subjects were informed of the reinforcement. An extended interview was used to identify four levels of awareness: fully aware, an incorrect solution that led to 100 percent reinforcement, an incorrect solution that led to less than 100 percent but better than chance reinforcement, and unaware. The unaware subjects did not learn. Some subjects reported that they thought the click was annoying and tried to avoid it.

A study of the relation of retention and generalization to awareness was conducted by Manis and Barnes (1961). They asked their subjects to identify insignia as friendly or unfriendly. Each insignia consisted of four numbers, and the correct solution depended upon the position of the numerals 2 and 5. Subjects were informed that they would be told if they were right or wrong. After the reinforced trials, circles were substituted for numbers (e.g., three circles for the number 3), and subjects were told to respond with the same schemes they had been using. Then they were given the original task without reinforcement to measure retention. One direct question was used to determine awareness. The unaware subjects learned, generalized, and retained, but not as well as the aware subjects.

Research on Changing Content of Conversation

When subjects were asked to discuss the relative advantages of study in the fields of science, English, and art, Sullivan and Calvin (1959) were unable to condition an increase in time spent talking about any of the fields over several sessions. For each subject, the experimenter said "mmm-hmmm" each time he mentioned a specific field.

Krasner, Weiss, and Ullman (1961) tried to explain away that they conditioned subjects to use emotional words in TAT stories without the subjects being aware. Their

subjects were college students who had just finished readings on verbal conditioning and had each verbally conditioned a classmate. Subjects who had revealed no awareness during the question period later claimed that they had misunderstood the questions. Even though they all said later that they had noticed the reinforcement, they could not all state the correct response class.

Quay (1959) mailed questionnaires to his subjects after sessions in which he conditioned them to relate more of specific types of childhood memories. Only one of the 34 subjects was fully aware, although 15 more had noticed that he had said "un-huh" during their sessions.

On two types of tasks, Eisman (1959) demonstrated learning without awareness which he measured with a three-question interview. The first task was the identification of ink blots as human or anatomical, which were correct responses, or animal or botanical. The second task was to use the first person pronouns in constructing sentences. Subjects who received no reinforcement did not show acquisition. Those who were reinforced did learn. Further evidence of learning was in the extinction of the conditioned behaviors that occurred for the subjects on a full reinforcement schedule. Those on a partial schedule did not extinguish.

Nuthmann (1957) conditioned increased self-acceptance by saying "good" whenever her subjects indicated that

positive self-referrent statements were true and negative statements were false. However, flashing a light was not effective as a reinforcer for this behavior. She asked subjects to state the relationship of the reinforcement to their behavior. Those who were unable to conditioned as well as those who were.

Research on Changing Physiological Responses

Chatterjee and Eriksen (1962) conditioned a change in heart rate by presenting a word list and pairing an electric shock with certain words. They determined awareness with an interrogation and by having subjects indicate the frequency with which shock was paired with each word in a printed list. The more information they gave subjects at the outset, the more aware they were and the better they conditioned and extinguished. The subjects who had received no information were classified for awareness as revealed by the check list. The unaware subjects did not condition differently from the aware subjects.

Lacey and Smith (1954) also conditioned a change in heart rate by the same technique. They questioned their subjects before extinction and eliminated all those who were judged as aware. The unaware subjects almost all reported trying to formulate a plan, but their hypotheses were not even partially correct.

Summary

A variety of human behaviors have been conditioned with a variety of reinforcements. Whether or not such learning can be said to take place without awareness depends upon the experimenter's bias which is reflected in his definition of awareness and his procedures for demonstrating its presence or absence. There seems to be a direct relationship in the number of trials and the number of aware subjects and their levels of awareness. The number of questions has an even more marked correlation with awareness. "It is conceivable that all S's in the verbal conditioning paradigm would verbalize the contingency if enough questions are asked in the interview. Each question may provide S with some information about the contingency" (Greenspoon, 1963, p. 29). Levin (1961) elaborated on this idea.

> The content of the questions might have stimulated S to look back over the task, reorganize his impressions and thereby formulate a correct contingency. In other words, S might have been led to verbalize a correct contingency merely as a result of being questioned about the task. This form of suggestion would be difficult to eliminate since it could always be argued that S's response to any question is suggested to him by the content of the question and does not reflect something of which he was aware before the question was asked (p. 74).

Experimenters who interviewed their subjects as opposed to having them fill out a questionnaire generally

rated more subjects as aware and at higher levels of awareness. If the experimental situation during conditioning is analogous to a psychotherapy setting, the analogy can be extended to the interview as well, if not even more validly. The clinician is often interested in guiding the client to the recovery, or discovery, of experiences of which he is not conscious at present and possibly never was. He may even be unaware of the ways in which he is directing the client and of the specific responses he is striving for. Krasner and Ullmann (1963) concluded that the reported level of awareness is influenced by informational cues and is another form of behavior that can be conditioned. "It would seem reasonable to hypothesize that examiner behavior cues are more effective while the S is not aware that he is responding to them" (Krasner, 1958, p. 165).

If somehow all experimenter bias could be factored out of the data, there probably would be undeniable evidence for learning without awareness. Humans do seem to emit behaviors which they have learned without being able to state the conditions that prevailed during the learning or the present stimulus that elicited the behavior. "It is an outmoded and unnecessary assumption that the modification of behavior must be preceded by a correct understanding of the environmental contingencies" (Postman and Sassenrath, 1961, p. 134). Most of the evidence demonstrates that such learning takes place more slowly, less efficiently, and less

perfectly than when the learner is aware of all cues and contingencies.

Until recently the majority of research on human conditioning has been concerned with the demonstration of learning with or without awareness.

> Previous investigators have distinguished between verbalizers and nonverbalizers by such terms as aware-not aware, insightful-noninsightful, and conscious-unconscious, with inferential accompaniments comparable to the level of the constructs used. A number of papers (especially recently) have challenged the procedure of determining awareness or insight on the basis of the responses to a restricted set of questions. . . . The defining process is a function of the theoretical position for which the given research is supplying further information. . . . It is quite possible that one could establish very interesting and important empirical laws purely on the basis of defining awareness and unawareness in verbal conditioning on the basis of the responses of "Yes" and "No", respectively, to the question, "Do you know why I said 'good' during the experiment?" There is no doubt that the quantity of S's in the category unaware would diminish as the list of questions increased in length and specificity. The argument that the S's eliminated from the unaware group as defined by a given set of questions on the basis of one more specific question or a wink or a bit of gossip were not really unaware in the first place carries a number of theoretical and philosophical risks (Binder and Salop, 1961, pp. 392-396).

Most of the research has measured awareness with the criterion of verbalization. Thus verbalization has been regarded as an experimental tool rather than a phenomenon worthy of investigation. But more understanding of the processes of learning, problem-solving, and personality development can be gained through the study of what people

report about what, how, and why they behave as they do in learning and problem-solving situations. There is no need to go beyond the empirical data to infer intervening variables. Then the relationship of verbalization to various types of learning and problem-solving can be studied, as well as the conditions that will or will not lead to verbalization of what has been learned or solved and the recognition of reinforcements.

CHAPTER II

PROBLEM

This study was designed to investigate the verbalization of problem-solving behavior when correct responses were and were not reinforced by the experimenter and when the problem was and was not stated by the experimenter. Eriksen (1962) had suggested that learning without verbalization would be most likely to occur in simple learning situations with perceptual cues as behavioral guides. Such conditions would be as free as possible from the influence of previous experiences which might have emotional loading for subjects. Hence, it would be more appropriate to conjecture that if learning without verbalization did occur under such conditions, the phenomenon could be expected to occur in more complex, emotion-producing conditions.

A problem-solving task that called for motor behavior was used to minimize any effects of previous experiences and pre-formed habits of behavior. The experimenter's behavior and personality and interaction with subjects was removed as much as possible by using a mechanically presented perceptual reinforcement and a printed questionnaire.

Mandler and Kaplan (1956) found that "the results of this study indicate that in human verbal learning, the subjects' subjective evaluation of the reinforcing stimulus may provide an independent measure of the reinforcing value of a verbal reinforcer" (pp. 582-583). So the questionnaire determined if the reinforcer was noticed, and if it was, whether it was annoying or distracting and was avoided.

The following hypotheses were tested:

1. There will be no learning without verbalization of the reinforcement contingency.

2. Learning will occur more efficiently when a problem has been stated and the reinforcement has been specified by the experimenter.

3. Subjects will tend to create a problem and find a solution for it when no problem has been posed externally.

4. The presence of some stimulus which might be perceived as associated with specific responses will emphasize this tendency to create a problem.

5. There will be no difference in the performance of those who verbalize the reinforcement contingency without leading questions and those who need more prompting.

6. If there are differences in performances, they will be associated with how the subjects regard the reinforcement stimulus.

CHAPTER III

EXPERIMENTAL PROCEDURE

Subjects

Subjects for the experiment were 66 volunteer undergraduate students at the University of Oklahoma. They were assigned to four groups.

There were 17 subjects in Group I, which was a control group that received no reinforcement. There were 17 subjects in Group II, which was also a control group, but received the visual reinforcement of a flash of red light for every response made. There were 16 subjects in both Groups III and IV which were experimental groups receiving the reinforcing red light each time the correct response was made. Groups I, II, and III were not informed that they were to solve a problem or that the red light would flash. Group IV was told that they were to solve a problem and that a red light would flash each time the correct response was made. The subject with the first appointment was placed in Group I, the second subject was placed in Group II, the third subject in Group III, and the fourth in Group IV. All the following subjects were assigned to groups in the same

order. This method of assignment was used to eliminate any bias that might have been caused by the time of day of testing.

Equipment

The problem-solving box designed and used by Teska (1942) was used. The box is constructed of wood with a slanted surface facing the subject. This side of the box has an opening approximately five inches square which is covered with translucent material that is divided into four equal quadrants. Above this opening is a pin point opening also covered with translucent material. At the side of each of the quadrants is a push button. Inside the box are a white light bulb that illuminates the larger opening and a red light that illuminates the smaller opening.

Opaque discs fit between the white light and the screen. In each disc triangles and squares are cut out for the light to shine through and appear on the screen. The arrangement of figures is such that a triangle appears in one quadrant and a square in another and two quadrants are blank. Each disc contains 20 combinations. When the button next to the quadrant that has been designated as correct is pushed, the red light behind the smaller opening is turned on for one second. Three seconds after a button has been pushed the disc is automatically rotated to the next combination.

Method

Subjects in Groups I, II, and III received the following instructions:

> You are taking part in a study of the relation of perception to choice behavior. In the center of the box in front of you is a square screen divided into four equal parts. Next to each one of the four parts is a button. Figures appear in some of the four small squares on the screen and some of the squares are blank. You are to choose one of the buttons to push for each combination. Each combination will remain on the screen until you push one of the buttons and for a few seconds afterwards. Then a new combination will appear on the screen, and you are to push one button each time a new combination appears. Do not push more than one button for any one combination. Do you have any questions? (Questions were answered by repeating the relevant portion of the instructions.)

Subjects in Group IV received the following instructions:

> You are taking part in a study of problem-solving behavior. In the center of the box in front of you is a square screen divided into four equal parts. Next to each one of the four parts is a button. Figures appear in some of the four small squares on the screen and some of the squares are blank. You are to choose one of the buttons to push for each combination. Each combination will remain on the screen until you push one of the buttons and for a few seconds afterwards. Then a new combination will appear on the screen, and you are to push one button each time a new combination appears. Do not push more than one button for any one combination. Each time you push the correct button, a red light will flash. Do you have any questions? (Questions were answered by repeating the relevant portion of the instructions.)

Then 60 trials were given. The red light was concealed for Group I. The red light flashed each time a button was pushed for Group II. For Groups III and IV, the red light flashed each time the button next to the triangle was pushed. The experimenter sat to the right and to the rear of the subjects, recording on a tally sheet each response each subject made. When the trials were completed, each subject was handed a questionnaire in booklet form with one question at the top of each page and the following instructions on the cover page:

> You are to follow the instructions at the top of each page in order. Do not turn a page until you have completed it. You are not to go back to a previous page. Do not turn back.
>
> 1. State why you chose the buttons you did. Be as explicit and complete in your answer as possible.
>
> 2. Did you notice anything happening while you were doing this test?
>
> 3. If your answer to 2 was yes, state if what you noticed had any, and if any, what effect on your choice of buttons.
>
> 4. Did you notice a red light turning on during the experiment?
>
> 5. If your answer to 4 was no, stop here. If it was yes, state if the red light had any, and if any, what effect on your choice of buttons.
>
> 6. Did you find the red light annoying or distracting?
>
> 7. How hard did you try to turn on the light? Check one.
> Avoided_____Not at all_____Some_____
> Most of the time_____All the time ____

CHAPTER IV

RESULTS

To test Hypothesis 1, learning was measured by counting the number of times the button by the triangle was pushed. The mean for Group I was 23, the mean for Group II was 22, the mean for Group III was 22, and the mean for Group IV was 50. The mean for all groups was 30 (see Table 1). Subject 7 in Group III was counted by the number of times he did not push the triangle button since this subject stated that the red light was avoided.

TABLE 1

MEAN NUMBER OF TIMES BUTTON BY TRIANGLE PUSHED FOR 60 TRIALS

	Groups				
	I	II	III	IV	Total
N	17	17	16	16	66
Mean	23	22	22	50	30

The mean of the total sample was selected as the breaking point for the χ^2 analysis of the data. In Group

III there were six subjects who fell above this point. Of these, three verbalized the reinforcement contingency. Ten subjects fell below the breaking point, and three of them verbalized the contingency. The probability of this occurring is .33 and is not significant (see Table 2).

TABLE 2

COMPARISON OF PERFORMANCE OF SUBJECTS IN GROUP III VERBALIZING AND NOT VERBALIZING CONTINGENCY

N = 16

	Verbalized Contingency	Did Not Verbalize Contingency	Fisher's Exact Probability
Pushed Correctly More Than 30 Times	3	3	.33@
Pushed Correctly Less Than 30 Times	3	7	

@Not significant at .05 level

Group III was compared to the control subjects, Groups I and II, using the same criterion of 30 correct responses. In each control group 5 subjects pushed the button by the triangle more than 30 times, while 12 subjects pushed it less than 30 times. In Group III 6 subjects were above and 10 below the breaking point. The obtained χ^2 of .31 was not significant with two degrees of freedom (see Table 3). Hypothesis 1 must be rejected, but with the

reservation that the performance of the experimental subjects did not differ significantly from the control subjects.

TABLE 3

COMPARISON OF PERFORMANCE OF GROUP III WITH GROUPS I AND II

	Group I N = 17	Group II N = 17	Group III N = 16	Degrees of Freedom	χ^2
Pushed Correctly More Than 30 Times	5	5	6	2	.31@
Pushed Correctly Less Than 30 Times	12	12	10		

@Not Significant at .05 level

Group III was compared with Group IV to test Hypothesis 2. Fifteen subjects from Group IV responded correctly more than 30 times, while only one subject from that group failed to reach this criterion of performance. Ten subjects from Group III made the correct response less than 30 times and six subjects made the correct response more than 30 times. Using Yates' correction for small samples, a χ^2 of 6.78 was obtained. With one degree of freedom, this value is significant at the .01 level (see Table 4). Hypothesis 2 is tenable.

TABLE 4

COMPARISON OF PERFORMANCE OF GROUPS III AND IV

	Group III N = 16	Group IV N = 16	Degrees of Freedom	χ^2
Pushed Correctly More Than 30 Times	6	15	1	6.78*
Pushed Correctly Less Than 30 Times	10	1		

*Significant at .01 level

Since Group III did not differ significantly from the control groups, Group IV can be said to differ from the control groups to the same degree it differed from Group III. Thus the response behavior of Group IV demonstrated that learning occurred.

Eleven of the 17 subjects of Group I described response patterns that were not random. In Group II 13 of the 17 subjects verbalized non-random behavior as did 9 of the 16 subjects in Group III. In answer to the first question of the questionnaire, these subjects indicated that they had formulated problems for which they arrived at solutions. Examples of the solutions are: "First, I didn't know exactly which button to push, but then I decided I would push the square each time to keep some order about it." "I was trying to perceive a certain pattern that followed with a certain button. Also, to see

if the same pattern would appear twice for the same button." "I chose the buttons that were clearer and closer to the center." "Because the triangle always seemed the one that didn't correspond to the others. The blank squares were 'square', plus the other square, so the triangle didn't belong." Examples of random behavior are: "Sometimes I pushed the button which corresponded to figure that attracted my eye more and sometimes I just pushed a different button to break the monotony." "I chose the buttons simply (after I got started) as to my first reaction to push. Just strictly by feeling." "Well, why not. It was like gambling. Who wants to press the same button all the time. Also the instructions said we could press any button." "For no particular reason."

Thirty-three out of 50 subjects described behavior that was not random. The statistical probability of this occurring is 2 times out of 100. Hypothesis 3 can be accepted since the tendency to pose a problem and find a solution to it was demonstrated to exist beyond chance although it is not a universal phenomenon.

A χ^2 comparison was made to determine if the red light which could be interpreted as a reinforcement by the subjects would lead to greater numbers of subjects establishing patterns of response. With two degrees of freedom, the χ^2 of 1.55 (see Table 5) was not significant and Hypothesis 4 was rejected.

TABLE 5

COMPARISON OF THE VERBALIZATION OF RESPONSE PATTERNS BY GROUPS I, II, AND III

	Group I N = 17	Group II N = 17	Group III N = 16	Degrees of Freedom	χ^2
Non-Random Responses	11	13	9	2	1.55@
Random Responses	6	4	7		

@Not significant at .05 level.

All but two subjects in experimental Group III reported that they saw the red light. Only six reported that they thought the red light was contingent upon the responses they made. Three of them reported this in answering the first question. They were Subjects 7, 35, and 47. Subject 7 reported that at first he tried to light the red signal and later tried to avoid it which he did successfully on 53 trials. However, he did not state his solution. Subject 35 said that he tried to get the red light most of the time and succeeded 38 times. His solution was "every time I chose a pattern I had chosen before." Subject 47 reported the correct solution and pushed the correct button 33 times. He tried to turn on the red light all the time.

Subject 27 also verbalized the correct solution, but did not state the solution or the contingency until answering

the second question. He said he tried only some of the time to light the signal and did so only 13 times. Subject 51 verbalized the contingency in response to the second question. He also verbalized an incorrect solution which was the lower two buttons. Trying to get the reinforcement most of the time, he did so 26 times. Subject 11 stated the contingency on question 5, reported no solution, tried to push the correct button most of the time, and did so 24 times. None of these subjects said that the light was annoying or distracting.

The three subjects who verbalized the contingency before leading questions were asked did make more correct responses than the other three subjects who verbalized the contingency only with more direct questioning. However, the number of subjects is too small for any valid statistical analysis to be performed. Consequently, Hypotheses 5 and 6 cannot be tested.

CHAPTER V

DISCUSSION

This experiment was designed to eliminate variables that might have differential meanings to the subjects. The task itself was easy. Hensley (1957) found that only four subjects in his dull group having mental ages of 6-2 or 6-1 and chronological ages of 7-0 to 7-3 failed to solve this problem in 60 trials. Some of the subjects in the present study reported that they became bored or tired. "The triangle always got the correct signal. I chose the square only to interrupt the monotony of pushing the triangle button." "Then I became bored and curious and decided to experiment." "Sometimes I just pushed a different button to break the monotony." "At first I wanted to stick with the triangle until I got tired of them. Then I just pushed the button for the square for a change but I wouldn't give up on the triangle." "Then sometimes I got tired of pushing the same button so I changed."

The stimuli used for the task were simple geometric shapes with which it was assumed all the subjects would have had similar experiences. However, the shapes seemed to have special meaning for some of the subjects. "I

thought the triangle was more beautiful and interesting." "Because a square is clear-cut and well structured." "My choice for choosing the buttons I did was due to the preference of the completeness of a square as opposed to the suggestive incompleteness of a triangle. There are four points to a square making an even number while there are three points in a triangle giving an odd number." "I chose the triangle most often because I like the shape of it better than a square." "No reason except I always chose a square or triangle because I don't like blank spaces." "I chose the triangle because it is a more interesting shape." Subjects could be screened with a semantic differential to eliminate those for whom the stimuli did not have neutral, or at least the same, meanings.

Wolpin and Milgram (1962) found no difference in the performance and verbalization of subjects receiving recorded verbal reinforcements designated as positive for one group and equivocal for another group. Using shock, a mechanical tone, and "um-hmmm" as reinforcements, Dulany (1962) did not demonstrate any significant difference in their effects on learning. However, more experimenters found that the type of reinforcement affected performance and verbalization. Binder, McConnell, and Sjoholm (1957) demonstrated that two different experimenters obtained different results. Buss, Gerjuoy, Irma, and Zusman (1958) found verbal reinforcement produced less verbalization of the contingency than did

cigarettes and candy and chips, while Binder and Salop (1961) found that verbal reinforcement produced more verbalization than a green light. Some of the subjects used by Wilson and Verplanck (1956) interpreted the experimenter's writing down responses as a negative sign and some of Tatz's (1960) subjects reported that a mechanical click was annoying and they avoided it. Such reports indicate that when verbal reinforcement is used, the experimenter, his tone of voice, and the subjects' past experiences might be sources of variation that would be unaccounted for.

A simple visual stimulus, a red light, was selected for the reinforcement in this experiment. The questionnaire included two questions to determine the emotional content of the red light. Seven of the 48 subjects who reported seeing the red light said that it was annoying or distracting, but only three subjects said that they tried to avoid it. One of these three was in Group I. In informal questioning following completion of the printed questionnaire, this subject was unable to tell where the red light was or when it was seen. This subject must be suspected of having had some information, although erroneous, about the experiment. The subject from Group II who tried to avoid the light did not say it was annoying or distracting. Of course, this subject could not avoid the red light. The light was not annoying or distracting to the subject from Group III who

tried to avoid it. This subject was successful in his attempt 53 times, but was unable to verbalize the correct solution.

The only subject in Group IV who felt the light was annoying and distracting tried to turn it on most of the time, which he did 50 times; only five in this group performed less well. Of the two subjects in Group III who thought the light was annoying or distracting, one did not try to light it and did so only 8 times, and the other tried some and did 45 times. The latter was considered to have learned, but neither verbalized the contingency or correct solution. Of the three subjects from Group II who reported that the red light was annoying or distracting each reported different efforts to turn it on, one not at all, one some, and one all the time. One subject in Group II and two subjects in Group III did not report seeing the red light. However, one of the latter never pushed the button by the triangle and so never turned on the red light.

These reports indicate that a red light is not a neutral stimulus that all subjects perceive the same way. Many subjects thought it was a part of the mechanism, while others tried to find out how to turn it on. No pattern of the relationship of how the subject felt about the reinforcement and his performance or verbalization was apparent. The safest approach to reinforcing behavior that is to be learned seems to be to make certain that the reinforcer is

desired by the learner. A better method for this experiment would have been to determine the color each subject liked best and to use that color for the reinforcement.

The physical situation for this experiment was simple. There was nothing in the room except chairs, table, the problem box which contained both the problem and the reinforcement, and the experimenter recording responses. In other words, there was a minimum of clues to guide behavior, just the forms on the screen and the reinforcement when it was appropriate. However, three subjects responded because of what they perceived as other relevant cues in the figures on the screen. "I would choose what seemed to me to be the largest of the two." "I chose the buttons that were clearer and closer to the center." "I picked the buttons because of the way the square or triangle were centered in the square. The less fuzzier or the better centered in the square, the more I liked it." These could not be considered real cues since none of these subjects responded consistently to the patterns each time they appeared on the screen.

Another false clue was the experimenter's behavior. The experimenter marked every response of every subject on a tally sheet. Twenty-five subjects reported that they noticed the experimenter marking the sheets, and seven of them reported that their behavior was thereby influenced. "I think after I noticed his writing down the answers, I

chose the block with the square in it more often." "It made me think, at first, that there may be some sort of pattern and that possibly he was testing to see if I would consider finding one." "I caught myself trying to figure out his marking system according to the answer." "I was more likely to switch between square and triangle whereas I might have only chosen triangle." "I would probably kept on choosing buttons by 'dominance' as I started out--but I knew he was watching--so I thought I would try something a little more intelligent (?)." "I think it sometimes changed my routine because he was watching." "I didn't push as many consecutive buttons as I might have otherwise."

None of the seven who were influenced by the experimenter's actions nor any of the three who found other irrelevant cues for behavioral guides were in Group IV. Group IV was informed that there was a problem to solve and that a red light would indicate a correct response.

In this particular experiment, there seems to be no way in which to control the perception of false cues in the figures. These cues were not physically real and so could be said to have been created by the subjects. However, the experimenter could have observed the subjects through a one-way mirror. With this procedure more subjects in Group III would possibly have recognized the red light as a reinforcement or have pushed the button by the triangle more often.

The utilization of false cues seems to be related to the tendency of a significant number of subjects to state solutions for problems when no problems were posed externally by the instructions. Harlow, Harlow, and Meyer (1950) demonstrated a similar phenomenon with monkeys that were exposed to a puzzle lock. The experimental group was given the puzzle locked. The control group received the solved puzzle. The experimental group worked with the puzzle and learned how to unlock it. Throughout 14 days of observation, they showed no decrease in the amount they worked with the puzzle. The controls did not pay as much attention to the lock. There was no extrinsic reward given to either group.

No analogous research with humans has been reported. However, research has been done to study self-reinforcement in situations where correct behaviors were not externally reinforced. Johnston (1955) used a maze problem to demonstrate the superior performance of subjects rated to have high achievement imagery as compared to those rated as low. Davis and Hess (1962) used an anagram task to investigate the relation of levels of awareness to learning. The difference in the present study is that there was no problem inherent in the task presented to Groups I and II.

Harlow, Harlow, and Meyer (1950) concluded from the behavior of their monkeys that they had demonstrated the learning process motivated by a manipulation drive. Other authors have alluded to behavior that is not externally or physiologically motivated. Seward (1963) spoke of

effectance as a motive for activity that is intrinsically rewarding. White (1959) defined effectance as the element that activates behavior directed toward the goal of competence. Competence includes all motives that are not accounted for experimentally as being derived from homeostatic needs such as exploration, activity, manipulation, mastery, sense of industry or achievement, motility, excitement, and novelty. Ryan (1958) included task as an essential part of motivation. Task is "a directly observable part of our experience. It is the answer to such questions as 'What are you doing?', 'What are you trying to do?', 'Where are you going?', 'What for?'" (p. 78), and "State why you chose the buttons you did."

Harlow (1953) cited laboratory situations in which learning was observed to occur without the reduction of any drive. According to him, organisms from rodents to humans engage in what he called exploratory behavior motivated by what he called curiosity. This experiment provided no basis for applying Harlow's terminology to the behavior of the present subjects in Groups I and II. The equipment used could provide such a study by using the conditions that the two control groups were exposed to and then placing discs programmed with real problems in the problem box for the same subjects. Such a technique would provide a comparison of the performances of those subjects who respond randomly and those who do not.

The phenomenon of the subjects creating their own problems for which they created their own solutions which they reinforced themselves might well be a "so what" finding. However, further research is suggested that could have important meaning for structuring learning situations. One question is how such subjects would subsequently perform on solving a real problem after establishing a behavior pattern that has been internally reinforced. Comparison could also be made of the subjects who responded randomly and those who did not on ability to solve other types of problems such as anagrams, mazes, or sentence construction. If differences were demonstrated, then investigations to identify related personality variables would be in order.

Group III did not yield adequate data for a definitive resolution of the issue of the relationship of verbalization to learning. The statistical analysis indicated that there was no difference in the performance of the verbalizers and non-verbalizers. But Group III did not perform better than the control groups, so they could not be said to have performed better than chance. Consideration must be given to the idea that the method of counting correct responses was not adequate to determine learning. Further trials without reinforcement would give information of the extinction of a learned behavior. A retest to measure retention would provide an additional measure of learning. There have been few attempts to measure retention such as those by Manis and Barnes (1961) and Sassenrath

(1962). The time lapses they introduced were short--no more than an hour.

The facilitation effect on learning of increased information which was demonstrated in this study supports the findings of Postman and Jarrett (1952). Their research was a refutation of that done by Irwin, Kauffman, Prior, and Weaver (1934), who found that subjects who were informed as to the purpose and correct principles involved performed no better than uninformed subjects. Further research to measure retention would be desirable, since both educators and therapists are more interested in permanent changes in behavior than they are in the speed with which such changes are made.

From the data of this study no statement can be made in support or rejection of the hypothesis that learning cannot occur when the subject does not verbalize the reinforcement contingency. The relationships of learning performance to the amount of prompting needed to elicit verbalization of the reinforcement contingency and of performance to the subject's emotional reaction to the reinforcement were not testable. Learning was demonstrated to occur more efficiently when the problem and reinforcement were stated by the experimenter. Many subjects formulated problems and solutions when no problem was stated, but this phenomenon was not affected by the presence of a stimulus that was intended to represent reinforcement. This study suggests that complete information and unambiguous reinforcement provide the best conditions for learning.

CHAPTER VI

SUMMARY

The effects of various conditions of reinforcement and various amounts of information on learning and verbalization of what was learned and why were investigated. Emphasis was placed on avoiding inferences of awareness made from the verbalizations of the subjects. The intent was to direct attention to the phenomenon of verbalization as a factor involved in changing or controlling or learning behavior. Efforts were made to provide as simple and neutral situation as possible. Stimuli were selected with the belief that all subjects would have had similar experiences with them and that they would be free of emotional meaning.

Teska's problem box, which was used to present the task, contains a screen with equal quadrants on which combinations of a square, a triangle, and two blank spaces were illuminated. A button is placed adjacent to each quadrant. Discs containing 20 combinations each were programmed so a red light above the screen turned on when a specified button was pushed. Pushing a button also activates the mechanism that brings the next combination onto the screen.

Sixty-six undergraduate students at the University of Oklahoma volunteered to be subjects. They were assigned to two control groups and two experimental groups. Control Group I could not turn on the red light with any button. Control Group II turned the light on each time they pushed a button. Experimental Groups III and IV turned on the light when they pushed the button by the triangle. Groups I, II, and III were instructed to push any buttons they wished, and no problem was introduced in the instructions. Group IV was told that they were to solve a problem and that each time a correct response was made the red light would go on. Each subject was given 60 trials.

When each subject completed the trials, he was given a questionnaire to determine why he was responding as he did, what cues he was utilizing, and the effect of the red light. Learning was measured by the number of times the button by the triangle was pushed. Comparisons of the learning by the groups were made with χ^2's for small populations.

Group IV learned significantly better than the other groups. Within Group III, there was no significant difference in the performances of those subjects who verbalized that the red light was related to pushing the correct button and those who did not verbalize the reinforcement contingency. However, the learning performance of Group III did not differ significantly from that of the control groups. Of the 50 subjects for whom no problem was externally stated

34 verbalized that they did not behave randomly. This proportion was significantly different from chance. The red light had no effect on this tendency, since Groups I, II, and III did not differ significantly in this respect. The red light had differential meanings to the subjects, but there was no identifiable relation between the meaning and performance. The triangle, square, and blank spaces, also, were not perceived with the same feelings by all subjects. Further, subjects found cues in the situation that were not inherent in the stimuli.

The study suggested refinements that might be made in future research. The experiment demonstrated the phenomenon of subjects creating problems, solving them, and reinforcing the solutions themselves. The process seems worthy of investigation to determine if it hampers or facilitates learning and if it is related to personality variables. Learning occurred most efficiently when the problem was explicitly stated and when the reinforcement was clearly identified.

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APPENDIX

TABLE 6

VERBALIZATION AND PERFORMANCE OF GROUP I

Subject	Correct Responses	Verbalization			
		Solution	Correct Solution	Reinforcement Contingency	
				Without Leading	With Leading
1	10	x			
5	17	x			
9	20				
13	0	x			
17	37				
21	18	x			
25	32	x			
29	60	x	x		
33	0	x			
37	0	x			
41	26				
45	19	x			
49	60	x	x		
53	17	x	x		
57	29				
61	24				
65	35				
Total	404	11	3		
Mean	23				

TABLE 7

VERBALIZATION AND PERFORMANCE OF GROUP II

Subject	Correct Responses	Verbalization			
		Solution	Correct Solution	Reinforcement Contingency	
				Without Leading	With Leading
2	27				
6	18	x			
10	1	x			
14	1	x			
18	32	x			
22	60	x	x		
26	60	x	x		
30	0	x			
34	14	x			
38	13	x			
42	6	x			
46	40	x			
50	21				
54	45	x	x		
58	15	x			
62	19				
66	18				
Total	390	13	3		
Mean	22				

TABLE 8

VERBALIZATION AND PERFORMANCE OF GROUP III

Subject	Correct Responses	Verbalization			
		Solution	Correct Solution	Reinforcement Contingency	
				Without Leading	With Leading
3	34				
7	53			x	
11	24				x
15	8	x			
19	45				
23	49	x	x		
27	13	x			x
31	10				
35	38	x		x	
39	0	x			
43	14	x			
47	33	x	x	x	
51	26				x
55	11	x			
59	29	x			
63	16				
Total	357	9	2	3	3
Mean	22				

TABLE 9

VERBALIZATION AND PERFORMANCE OF GROUP IV

Subject	Correct Responses	Verbalization			
		Solution	Correct Solution	Reinforcement Contingency	
				Without Leading	With Leading
4	14	x			
8	49	x	x	x	
12	52	x	x	x	
16	60	x	x	x	
20	59	x	x	x	
24	58	x	x	x	
28	58	x	x	x	
32	50	x	x	x	
36	58	x	x	x	
40	57	x	x	x	
44	41	x	x	x	
48	48	x	x	x	
52	59	x	x	x	
56	58	x	x	x	
60	56	x	x	x	
64	32	x	x	x	
Total	809	16	15	15	
Mean	50				